

REMARKS

In response to the Official Action mailed on November 3, 2004, the application has been amended. No new matter has been added. Reconsideration of the rejections of the claims is respectfully requested in view of the above amendments and the following remarks.

On pages 3 - 7 of the Official Action, the claims received the following rejections:

(a) Claims 1, 9, 10, 13, and 15 were rejected under 35 USC 102(b) as anticipated by Shimada et al (U.S. Patent No. 6,087,597, referred to below as Shimada),

(b) Claims 1, 3, 4, 8, 11, and 12 were rejected under 35 USC 102(e) as anticipated by Inoue et al (U.S. Patent No. 6,460,755, referred to below as Inoue), and

(c) Claims 1 - 3, 6, 7, 9, 11, and 13 were rejected under 35 USC 102(e) as anticipated by Cheng et al (U.S. Patent No. 6,596,620, referred to below as Cheng)

These rejections are respectfully traversed.

Amended claims 1 and 15 describes a solder ball assembly or a ball assembly including a polymeric fixing agent which secures the solder balls in the holes and prevents the solder balls from falling out of the holes when the mask is oriented such that the solder balls would fall out of the holes in the absence of the fixing agent. Amended claims 1 and 15 are supported by page 6, lines 22 - 25 of the specification as filed, which state that the fixing agent can prevent the solder balls from falling out of the

holes in the mask if the mask is turned upside down, and page 10, lines 1 - 5 of the specification as filed, which describe a variety of polymeric fixing agents. An example of a state in which the mask is oriented such that the solder balls would fall out of the holes in the mask in the absence of the fixing agent is when the mask is turned upside down with respect to the state shown in any of Figures 1 - 4, with the upper protective sheet 6 removed. None of the references discloses or suggests such an arrangement.

Shimada discloses an electronic device assembly in which spherical connecting members 10 are disposed in through holes 25 formed in an insulating film 21 of a tape carrier 20. The connecting members 10 are maintained inside the through holes 25 by solder 13 which is soldered to a conductor pattern 23 lining the through holes 25. There is no disclosure in Shimada of any polymeric fixing agent at all.

Inoue discloses a bump forming method and apparatus for mounting solder balls on a BGA package in order to form solder bumps. As part of the method, solder balls 61 held by a suction arraying jig 50 are immersed in a liquid film of flux 70 to wet the solder balls 61 with the flux 70, and then the arraying jig 50 places the solder balls 61 onto a semiconductor package 75 to which the solder balls 61 are to be joined.

The Official Action describes the flux reservoir 318 shown in Figure 38 of Inoue for holding the liquid film of flux 70 as corresponding to the mask of claim 1 or 15 and describes the liquid flux 70 as corresponding to the fixing agent of claim 1 or

15. Regardless of whether the flux reservoir 318 can properly be described as a mask, the liquid flux 70 does not correspond to the polymeric fixing agent of amended claim 1 or 15, because there is no indication that the liquid flux 70 is capable of preventing the solder balls 61 from falling out of the reservoir 318 were the reservoir 318 turned upside down (an inverted state of the reservoir 318 being an orientation of the reservoir 318 in which the solder balls 61 would fall out of the reservoir 318 in the absence of the liquid flux 70, regardless of the function performed by the flux 70). The flux 70 does have a certain degree of adhesive action (column 18, line 7 of Inoue describes the flux as a sticky liquid), but that stickiness need only be sufficient to prevent a spherical solder ball from rolling off a flat bonding pad of a BGA package prior to reflow soldering. There is no indication or suggestion that the stickiness of the flux 70 enables it to hold solder balls 61 in the reservoir 318 in an inverted state. Thus, the flux 70 does not correspond to the fixing agent set forth in amended claims 1 and 15.

Cheng discloses a BGA substrate via structure. In the device disclosed in Figure 2 of Cheng (the figure relied upon in the Official Action), a somewhat spherical shaped solder ball 27 is disposed in a via 15 of a dielectric substrate 22 and is connected to a patterned metal pad 26 on the chip-side surface of the dielectric substrate 22 by reflowed solder 21. There is clearly no disclosure of any polymeric fixing agent as set forth in amended claim 1 or 15.

Thus, as none of Shimada, Inoue, or Cheng discloses all of

the features of amended claim 1 or 15, they do not anticipate these claims or claims 2 - 4 and 6 - 13 which depend from claim 1. All of these claims are therefore allowable.

The above-mentioned differences in structure between the ball assemblies described by claims 1 and 15 and the devices set forth in Shimada, Inoue, and Cheng reflect the basic difference in function of the mask of a ball assembly described by these claims and the portions of the devices disclosed by the references which the Official Action refers to as masks.

A mask of a ball assembly according to the present invention is used to precisely position solder balls in a prescribed array atop electrodes on a substrate while the solder balls are formed into solder bumps, after which the mask can be removed, leaving the solder bumps on the substrate. As such, the purpose of the polymeric fixing agent is to form a temporary mechanical connection between the mask and the solder balls rather than an electrical interconnection. Because the fixing agent is polymeric, it does not become a part of the solder bumps which are formed from the solder balls which it secures in the mask. Therefore, the amount of solder in each solder bump can be precisely controlled by suitably selecting the size of the solder balls, without the need to worry about variations in the amount of fixing agent from one hole in the mask to another.

In contrast, the insulating film 21 of a tape carrier 20 in Shimada and the dielectric substrate 22 of Cheng actually form part of an electronic device. As such, the connecting members 10

of Shimada and the solder balls 27 of Cheng need to be electrically connected to other members when the insulating film 21 or the dielectric substrate is incorporated into an electronic device. For this reason, the connecting members 10 and solder balls 27 are retained inside the insulating film 21 of Shimada or the dielectric substrate 22 of Cheng by solder. Securing of members 10 of Shimada or solder balls 27 of Cheng with a polymer would render the resulting devices nonfunctional.

As for the flux reservoir 318 of Inoue, the sole purpose of the flux reservoir 318 is to act as a vessel for holding a liquid film of flux 70 for wetting the solder balls 61 with the flux 70 prior to the solder balls 61 being placed onto a semiconductor package 75. There is no need for the flux 70 to have properties enabling it to hold the solder balls 61 in the flux reservoir 318 when the reservoir 318 is in an inverted state. The flux 70 needs no more than a slight tackiness in order to serve its intended function. In fact, if the adhesive force of the flux 70 were so strong that it could hold the solder balls 61 in the flux reservoir 318 when the reservoir 318 were upside down, the adhesive force would interfere with the ability of the flux 70 to easily wet the solder balls 61. For these reasons, the cited references do not employ a fixing agent like that described by claims 1 or 15.

Certain of the characterizations of the references in the Official Action are incorrect. For example, the Official Action states, in connection with claim 2, that Cheng discloses a

protective sheet attached to the first side of a mask. However, what the Official Action refers to a protective sheet is not a sheet at all but a patterned metal pad corresponding to the printed wiring 16 shown in Figure 1. Thus, Cheng does not anticipate claim 2. Furthermore, the Official Action states, in connection with claim 6, that Figure 2 of Cheng discloses a parting agent in the form of solder 21, yet at the same time, the Official Action states that solder 21 is a fixing agent. A fixing agent and a parting agent perform diametrically opposed functions. The purpose of a parting agent is to prevent a molded article from adhering to the surface of a mold and to enable the molded article to be readily separated from the mold. In contrast, a fixing agent serves to secure to objects to one another. If the solder 21 is a fixing agent, it cannot be a parting agent and vice versa. Thus, it is impossible for Cheng to anticipate claim 6.

Regarding claim 7, the Official Action states that Figure 2 of Cheng discloses a protective sheet attached to the second side of a "mask" (dielectric substrate 22) covering the second end of each of the holes in the "mask". This is a misinterpretation of Figure 2 of Cheng. There is no member on the lower side of the dielectric substrate 22, and the solder balls 27 protrude, uncovered, from the open lower ends of the holes 15 in the substrate 22. If there were in fact any sort of protective layer over the lower surface of the substrate 22 or the solder balls 27 of Cheng, then it would be impossible to connect the solder balls 27 to a printed circuit board. It is also clear from Figure 1 of

Cheng, which shows essentially the same structure as Figure 2, that there is no protective sheet on the lower surface of the substrate 22. Therefore, Cheng cannot anticipate claim 7.

On page 7 of the Official Action, claim 5 was rejected under 35 USC 103(a) as unpatentable over Inoue in view of Klein (U.S. Patent No. 6,084,781). This rejection is respectfully traversed because even if the references were combined as proposed by the Official Action, the combined references would not result in an arrangement having all the features of claim 5.

Claim 5 depends from amended claim 1, which describes a solder ball assembly including a polymeric fixing agent which secures solder balls in holes in a mask and prevents the solder balls from falling out of the holes when the mask is oriented such that the solder balls would fall out of the holes in the absence of the fixing agent. As discussed above with respect to claim 1, there is no disclosure or suggestion in Inoue of a fixing agent having these characteristics. Klein was relied upon as teaching the use of a rosin flux to coat donut-shaped solder elements 110. According to column 7, lines 2 - 5 of Klein, the purpose of the flux is to provide sufficient tackiness to maintain the elements 110 in corresponding recesses 112 in a dielectric substrate 102. There is no teaching or suggestion that the flux has properties such that if it were used as the flux 70 of Inoue, it would have the ability to prevent the solder balls 61 of Inoue from falling out of the flux reservoir 318 if the reservoir were turned upside down. Indeed, there is no

reason to think that it should, since the flux used to coat the solder elements 110 in Klein only needs to have sufficient tackiness to prevent the solder elements 110 from sliding around on a horizontal surface of the substrate 102. Since the substrate 102 is never turned upside down, there is no reason for the flux to be able to support the weight of the solder elements 110 in a suspended state.

Therefore, as combining Inoue with Klein as proposed by the Official Action would not result in an arrangement having all the features recited in claim 1 and included in claim 5 by its dependence from claim 1, the proposed combination of references cannot render claim 5 obvious. Claim 5 is accordingly allowable.

On page 8 of the Official Action, claim 14 was rejected under 35 USC 103(a) as unpatentable over Shimada in view of Sota (U.S. Patent No. 6,201,707). This rejection is respectfully traversed because combining the references as proposed by the Official Action would not result in an arrangement having all the features of claim 14.

Claim 14 depends from claim 1, which describes a solder ball assembly including a polymeric fixing agent securing solder balls in holes in a mask. As set forth above, Shimada discloses an electronic device assembly in which spherical connecting members 10 are disposed in through holes 25 formed in an insulating film 21 of a tape carrier 20 by solder, and it contains no disclosure of a polymeric fixing agent. Sota discloses a wiring substrate having external terminals 12 made of solder disposed in through

holes 1 in an insulating base plate 5 of a wiring substrate 6. The Official Action relies upon Sota for the teaching that the insulating base plate 5 may be made of materials including polyimides, ceramics, paper, etc., and proposes to modify the arrangement of Shimada to employ such materials for the insulating film 21 of Shimada. However, even if Shimada were modified in such a manner, the connecting members 10 of Shimada would still be held in the through holes 25 of the insulating film 21 by solder 13, and there would be no polymeric fixing agent as set forth in claim 1 and included in claim 14 by its dependence from claim 1.

Therefore, as combining the references as proposed in the Official Action would not result in an arrangement having all the features set forth in claim 14, the references cannot render this claim obvious. Claim 14 is thus allowable.

Non-elected claims 16 - 20 have been cancelled, and new claims 22 - 24 have been added to describe additional features of the present invention. These claims are allowable as depending directly or ultimately from claim 1.

In light of the foregoing remarks, it is believed that the

present application is in condition for allowance, and favorable consideration is respectfully requested.

Respectfully submitted,

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